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# Urinary Mercury concentrations associated chewing gum in students of Faculty of Dentistry

**Dr. Musab Hamed Saeed,** B.D.S., M.Sc., Ph.D.*
**Dr. Waad M. Kheder,** B.D.S., M.Sc.**
**Dr. Iman M. Al-Zaka,** B.D.S., M.Sc.***
**Dr. Jamal A. Mehdi,** B.D.S., M.Sc.****

## Abstract

The aim of this study was to measure the urinary mercury concentration in students after chewing gum for certain period of time. Sixteen students from faculty of dentistry had used chewing gum for five hours a day for seven days. Urine sample collected 24 h before and after the experimental time. Total mercury in urine (U-Hg) was determined by means of inductively coupled plasma mass spectrometry (ICP-MS). t-test was used for the comparison of mercury before and after chewing gum. A non significant difference was found after chewing than before chewing gum.

**Key words: Dental restoration, Mercury concentration, Urine.**

## Introduction

Dental amalgam is one of major sources human exposure to organic and inorganic mercury respectively[1]. Although mercury has serious health effects of high exposure, debate continues regarding adverse health effects at low levels of mercury exposure from dental amalgam. The existing epidemiological literature on the health effect related to low levels of elemental and inorganic mercury exposure should be considered incomplete[2].

Dental amalgam restoration containing mercury have been used by dentists since the mid 19th century[3]. Amalgam restoration consists of mercury, silver, tin, copper, and trace amount of zinc. The dental amalgam has two fundamental flaws that adversely affect a patient's health. The first fundamental flaw is that all amalgam metals are cations. The net result of the tendency for covalent, ionic and metallic bonding and Vander Waals forces between amalgam cations is a weak repulsion. So, there is a sustained release of mercury and other metals from the amalgam into the body[3]. Researchers have measured a daily release of mercury on the order of 10 micrograms from the amalgam into the body[4,5]. The second fundamental flaw is that there are five dissimilar metals in the amalgam. Galvanic action between these metal is inevitable (the dissimilar metals from a battery). Galvanism produces electricity that flows through the body. The electric current produced by the

*Assist. Prof., College of dentistry, Ajman University of Science & Technology-UAE.
**Lecturer, College of dentistry, Ajman University of Science & Technology-UAE.
***Assist. Prof., College of dentistry, Al-Mustansiria University.
**** Assist. Prof., College of dentistry, Al-Mustansiria University.

amalgam typically are between 0.1 and10 microamps, compared to the body's natural electric current of 3 microamps[4,5].

Dental amalgam is the most diffused dental filling material. Since it is constituted for at least 40-45% of mercury, many questions have raised its safe use. Mercury particles from dental amalgam dissolve in saliva and being ingested, they reach the blood stream through the intestinal mucosa[6]. Previous studies have reported a positive association between urine mercury levels and the number of dental amalgam[7,8]. Many studies conformed that dental amalgam is a significant source of exposure to mercury in humans, mainly by inhalation of mercury. The conclusion was that dental amalgam is a source of low level exposure to mercury[4,9].

Few persons have higher uptake reported from their amalgam. Elemental mercury, as a vapor, which escapes from fillings, penetrates the blood-brain-barrier and enters CNS, where it is ionized and trapped, is attributing to it is significant toxic effects. It is not well absorbed by GI tract and when ingested, is only mildly toxic[10]. After absorption mercury vapor is rapidly oxidized in erythrocytes or tissues to inorganic mercury, so the tissue distribution and toxic effects of mercury vapor and inorganic mercury are the same[10]. Inorganic mercury has a markedly non uniform distribution after absorption. The highest concentration of mercury is found in the kidneys, where the metal is retained longer than in other tissue concentrate of inorganic mercury are similar in whole blood and plasma. Inorganic mercurial do not readily pass the blood brain barrier or the placenta[10,11].

In two fatal cases involving ethyl mercury in Iraq, 8-10 ppm were found in the kidney, 6-7 ppm in liver, 3-5ppm in cerebellum and 15ppm in blood[12]. Chemists and toxicologists, point out that not only does mercury escape, but it's release is greatly enhanced by chewing and heat. The World Health Organization (WHO)[9] notes that exposure can be greatly increased by personal habits such as bruxism or gum-chewing, and cites a report which found a 5.3 fold increase in mercury levels after chewing, eating, or tooth-brushing. They report that amalgam is estimated to contribute 50% of mercury exposure in adults.

There are some factors that have been proposed to raise the mercury efflux from amalgam filling in amalgam-bearers over the base-line value; chewing gum use has been shown to raise the mercury efflux into oral air[12].

Raise mercury levels in saliva after use of chewing gum has been reported. Nicotine chewing-gum users had about 5 times higher urinary mercury levels than non-chewing-gum users in a report of Sollsten et al.[13] Some of the nicotine-chewing-gum users in this report had urinary mercury levels as high as those usually found in occupationally mercury-exposed persons.

The aim of this study is to evaluate the effect of chewing gum on mercury urine content for subjects with amalgam restorations.

## Materials and method

The chewers were students recruited from the faculty of dentistry of Ajman University of science and technology, with an information letter to explain the aim and inclusion criteria. The sixteen chewers had to chew at least five hours of chewing gum per day for at least seven days (experimental time). We restricted the gender to females only and select

subjects with at least 4 amalgam surfaces.

Subjects collected a 24 hours urine sample at home in plastic bottle (before and after experimental time). The samples were stored in a deep freezer until analyzed.

Total mercury in urine (U-Hg) was determined by means of an inductively coupled plasma mass spectrometry (ICP-MS) INICP-MS, a plasma or gas consisting of ions, electrons and neutral particles is formed from Argon gas. The plasma is used to atomize and ionize the elements in a sample. The resulting ions are then passed through a series of apertures (cones) into the high vacuum mass analyzer. The isotopes of the elements are identified by their mass-to-charge ratio(m/e) and the intensity of a specific peak in the mass spectrum is proportional to the amount of that isotope (element) in the original sample.

Urine mercury level were determined in (µg/I urine), and measured using quantitative determinations. Data were collected and analyzed to obtain the results of the study. t-test was used for the comparison of mercury before and after chewing gum, since the parameters were normally distributed.

## Results

Of the sixteen subjects tested only five subjects showed higher urine mercury level after chewing gum for seven day five hours per day compared to their urine mercury level before start gum chewing. Five subjects showed non differences in urine mercury level before and after chewing gum. Surprisingly, six of the subjects showed low urine mercury level after chewing gum compared to the urine mercury level before start chewing gum (Table-1). T-test showed that urine mercury level was non significant after chewing than before chewing gum (Table-2).

## Discussion

The dental amalgam controversy refers to the conflicting views over the use of amalgam as a filling material mainly because it contains the element mercury. The concern centers on the health effects of toxicity or allergy which may be associated with constant mercury exposure, particularly as an alleged cause of chronic illnesses, autoimmune disorders, neurodegenerative diseases, birth defects, oral lesions, and mental disorders[14]. Scientists agree that dental amalgam fillings leach mercury into the mouth, but studies vary widely in the amount and whether such amount presents significant health risks. Estimations run from 1-3 µg/day (FDA) up to 27 µg/day. The present study shows that the increase in Hg uptake after frequent chewing is considerable, with mercury level in urine higher in some samples after chewing than before[14,15].

After chewing gum for 7days, five of volunteer's urine samples have an increase in the mercury level, and the rest either remains constant or decreased. Five sample mercury levels remains constant and six samples have decrease in the mercury level. Volunteers with increased mercury level are due to chewing gum effect that stimulates mercury leakage from amalgam fillings. Plus occupational exposure to amalgam mercury due to in appropriate handling of amalgam during working, plus mercury from fish consumption during the chewing week which has a small effect because the consumption of fish is not that much in middle east countries.

In the other hand volunteers with decrease mercury level as volunteer number (1, 3, 4, 5, 6, 13)(Table-1)

explained that they have a decrease in occupational exposure to amalgam mercury during the period we allow this group to chew because volunteers in the chewing week had stop working in the clinics due to the vacation they took before midterm exams, this makes attention to occupational exposure which a big effect on mercury level in the urine. As recommended by consumer union of US in 1991, the normal level for urinary mercury level is between 0-8 mg/g urine in which all volunteers before and after chewing gum are still in the normal level [(16)].

The mechanisms underlying the Hg release during/ after chewing are not well understood. The mechanical pressure/ sec are one possible factor. Moreover, mercury inside the amalgam filling diffuses and reaches the surface, where a concentration gradient of mercury prevails [(16)]. The concentration gradient on the surface can be disturbed by various processes, such as the chewing of gum or tooth brushing, resulting in an increased mercury release rate, and the surface can also be passivezed, resulting in a decreased release rate[(17)].

## Conclusion

The results of this study were obtained from the collected urine samples before and after chewing gum which drive up to the conclusion that chewing gum stimulates mercury release from dental amalgam fillings. The higher results obtained from this research were still within acceptable limits where there are no known health effects, but more dental filling and more chewing time may be problematic, and this can be avoided by replace them all.

## References


**1-** Eley BM, Cox SW. The release, absorption and possible health effects of mercury from dental amalgam: a review of recent findings. BDJ.1993; 175 (10): 355–62.

2- Pizzichini M, Fonzi M, Gasparoni A, Mencarelli M, Rocchi G, Kaitsas V, Fonzi L. Influence of amalgam fillings on Hg levels and total antioxidant activity in plasma of healthy donors. Bull Group Int Rech Sci Stomatol Odontol 2001 May-Sep;43(2):62-7.

3- Roberson TM, Heymann HD, Swift EJ. Art and Science of Operative Dentistry. Elsevier. St. Louis, Missouri 63146, 4th edition. 2002.

4- Berglund, A. Estimation by a 24-hour study of the daily dose of intra-oral mercury vapor inhaled after release from dental amalgam. Journal of dental research. 1990; 69 (10): 1646–51.

5- DAMS Inc. the dental amalgam Issue. Saint Paul: February 1997.

6- Pizzichini M, Fonzi M, Gasparoni A, Fonzi L. Salivary mercury levels in healthy donors with and without amalgam fillings. 2000 May-Dec: 42(2-3):88-93.

7- Kingman A, Albertini T, Brown J. Mercury Concentrations in Urine and Whole Blood Associated with Amalgam Exposure in a US Military Population. JDR March 1, 1998 77: 461-471

8- Dye B.A., Schober S.E., Dillon C.F., Jones R.L. Urinary mercury concentrations associated with dental restorations in adult women aged 16-49 years: United states, 1999-2000.

9- World health Organization (WHO). Elemental Mercury and Inorganic Mercury Compounds: Human Health Aspects, 2003; p. 11

10- Bellinger, DC; Trachtenberg, F; Barregard, L; Tavares, M; Cernichiari, E; Daniel, D; McKinlay, S. Neuropsychological and renal effects of dental amalgam in children: a randomized clinical trial. JAMA. 2006; 295 (15): 1775–83.

11- Hujoel P.P, Rochelle M.L, Bollen A.M, Woods S.J. Mercury Exposure from Dental Filling Placement during Pregnancy and Low Birth Weight Risk. Am J Epidemiol April 15, 2005 161: 734-740.

12- Gosselin R.C. Clinical toxicology of commercial products. 6th ed. Baltimore: Williams and Wilkins, 1984:267-268.

13- Sallsten G., Thoren J., Barregard L. Long term use of nicotine chewimg gum and mercury exposure from dental amalgam filling. J Dent Res. 1996 Jan; 75(1):594-8

14- Berregard L. Mercury from dental amalgam: Looking beyond the average- Occup. Environ. Med. 2005: 62:353-353
15- Koral, Stephen M. "The Scientific Case against Amalgam". International Academy of Oral Medicine and Toxicology. 2005.
16- World health Organization (WHO). Environmental health criteria. 118, Inorganic Mercury WHO Geneva 1991.
17- Mackert JR, Berglund A. Mercury exposure from dental amalgam fillings: absorbed dose and the potential for adverse health effects. Crit Rev Oral Biol Med 1997; 8:410436.

Table (1): Mercury level before and after chewing gum

| subject | U-Hg before(µg/l) | U-Hg after(µg/l) | subject | U-Hg before(µg/l) | U-Hg after(µg/l) |
|---|---|---|---|---|---|
| 1 | 2.50 | 1.00 | 9 | 1.00 | 1.13 |
| 2 | 1.00 | 1.00 | 10 | 1.00 | 1.00 |
| 3 | 1.30 | 1.00 | 11 | 1.00 | 1.00 |
| 4 | 1.10 | 1.00 | 12 | 1.00 | 1.00 |
| 5 | 4.10 | 1.00 | 13 | 1.30 | 1.00 |
| 6 | 2.00 | 1.00 | 14 | 1.00 | 1.20 |
| 7 | 1.30 | 6.50 | 15 | 1.00 | 1.60 |
| 8 | 1.10 | 1.36 | 16 | 1.00 | 1.00 |

Table (2): Student t-Test

| | Mean | SD | P-value | Sig |
|---|---|---|---|---|
| **Befor** | 1.418 | 0.83 | 0.989 | *NS |
| **After** | 1.424 | 1.364 | | |

*NS: non significant